Dynamic Self-Assembly of Electrostatically Driven Microparticles

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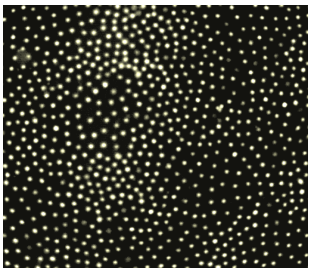
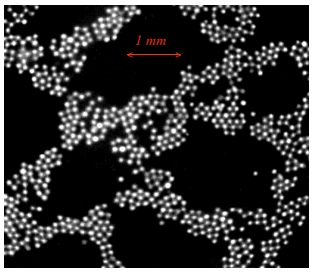
Self-assembly, the spontaneous organization of materials into complex morphologies, constitutes one of the greatest hopes to nanofabrication's challenge to create ever smaller structures. The science underlying the formation of nanostructured materials via self assembly is largely driven by thermodynamic forces. We present an entirely novel approach to self-assembly of nano and micro particles, which opens up the possibility to create new self-assembled patterns unbridled by the forces of thermodynamics and hence provide an extra knob to tune the organization of complex structures. The approach is motivated by the physics of granular material which has yielded a rich variety of self-assembled patterns. We extend this concept to the dynamics generated by continuous electrostatic excitation to manipulate and self-assemble small-particle arrays, taking advantage of the intrinsic tendency to form ordered patterns in particles subjected to a strong electric field. This method relies on the collective interactions between the particles due to competition between short range collisions and long-range electromagnetic forces.

Dynamic self-assembly of particles in liquid

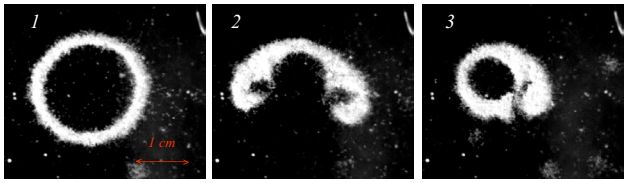
Lattice



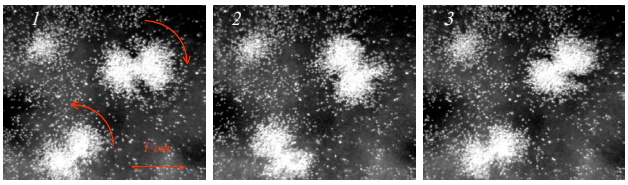
Honeycomb



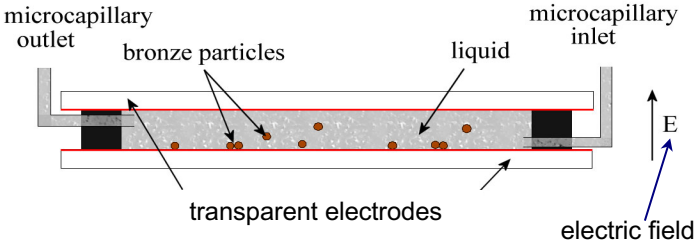
Periodically Pulsating Rings



Rotating Binary Vortices



Experimental setup

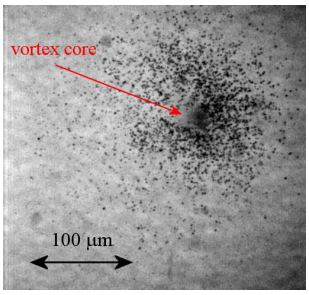


Base fluid: high purity toluene: Additive: 98% ethanol
40 or 150 mm Bronze spheres; Electric field: 0-15 kV/cm

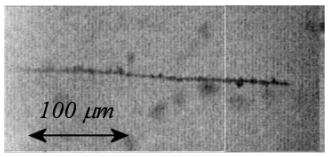
Towards to micro and nano size particles

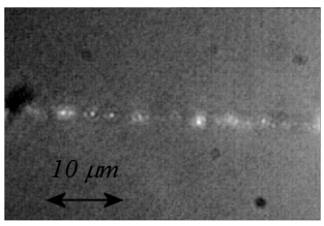
2μm Ag and Au particles in liquid

Microvortex

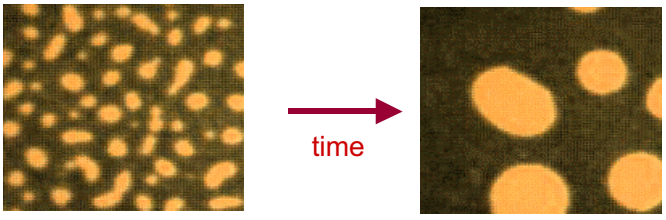


Chains

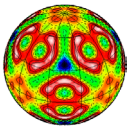




Coarsening of clusters of particles in air



M.V.Sapozhnikov, Y.V. Tolmachev, I.S. Aranson, W.-K. Kwok, Phys. Rev. Lett., 90, 114301 (2003)



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